Physical Properties of 70 Galaxy Clusters Observed by XMM-Newton

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Introduction to the Survey

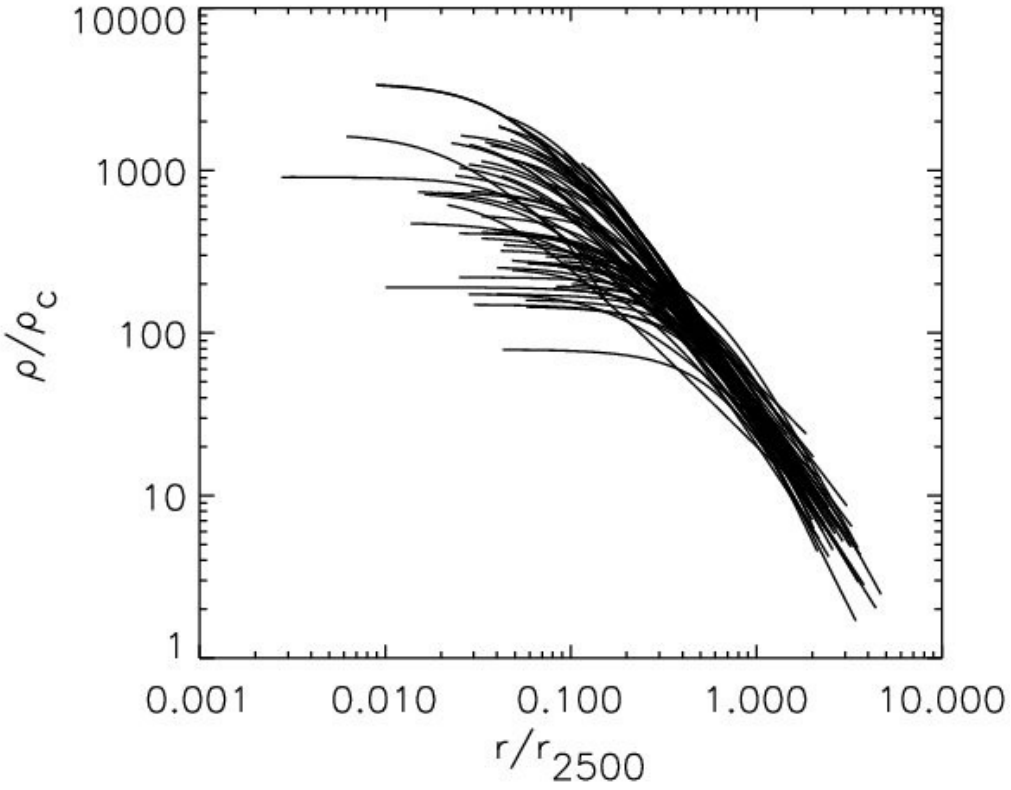
- 70 Clusters:
  - Distance: Virgo to z = 0.45
  - Temperatures: 1.8—14 keV
  - Masses: (0.2—9.0) x 10^{14} $M_{\odot}$
  - Highest signal-to-noise observations in archive.
- Initial data analysis presented in Snowden et al. 2008 (astro-ph/07102241).
  - Careful background subtraction.
  - Provides projected temperature, abundance, and electron density distributions (~10 annuli per cluster).
  - Only MOS data.

Data Analysis

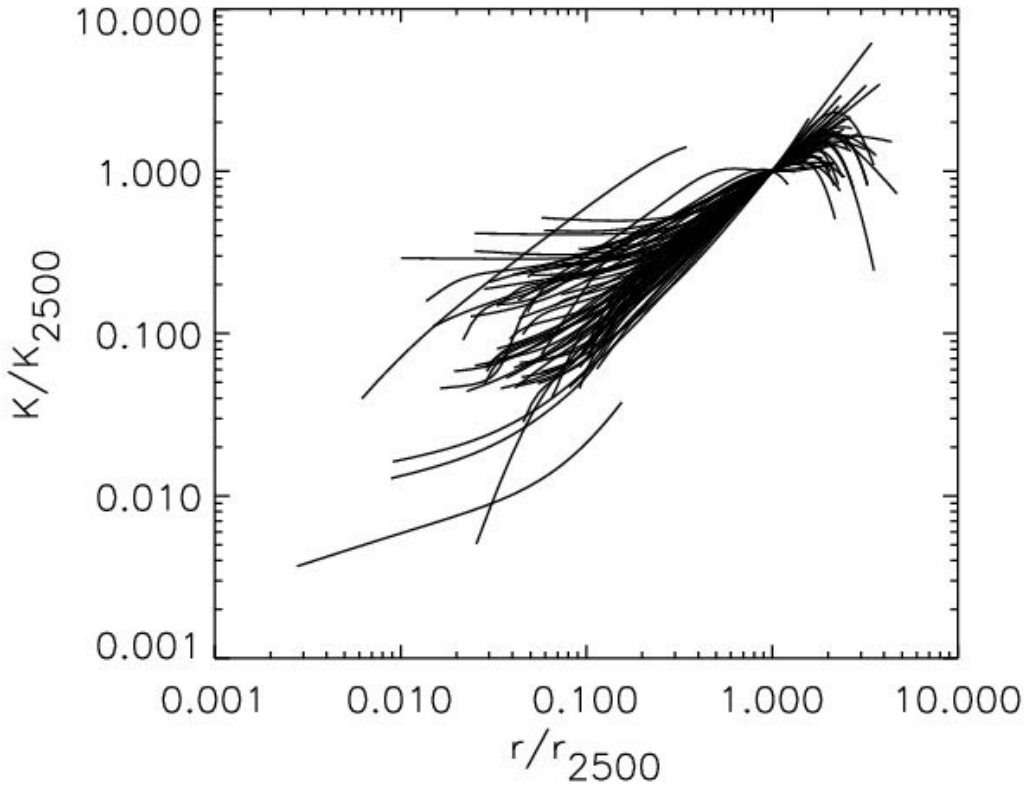
- Fit for radial (3D) distributions of electron density and temperature.
  - Used beta model for electron density.
  - Temperature model of Vikhlinin et al. 2006.
- From these derived distributions in:
  - Gas Mass
  - Total Mass, assuming hydrostatic equilibrium
  - Entropy
  - And calculated values at R_{2500} (other scales to come).

Distributions

Gas Density Distributions



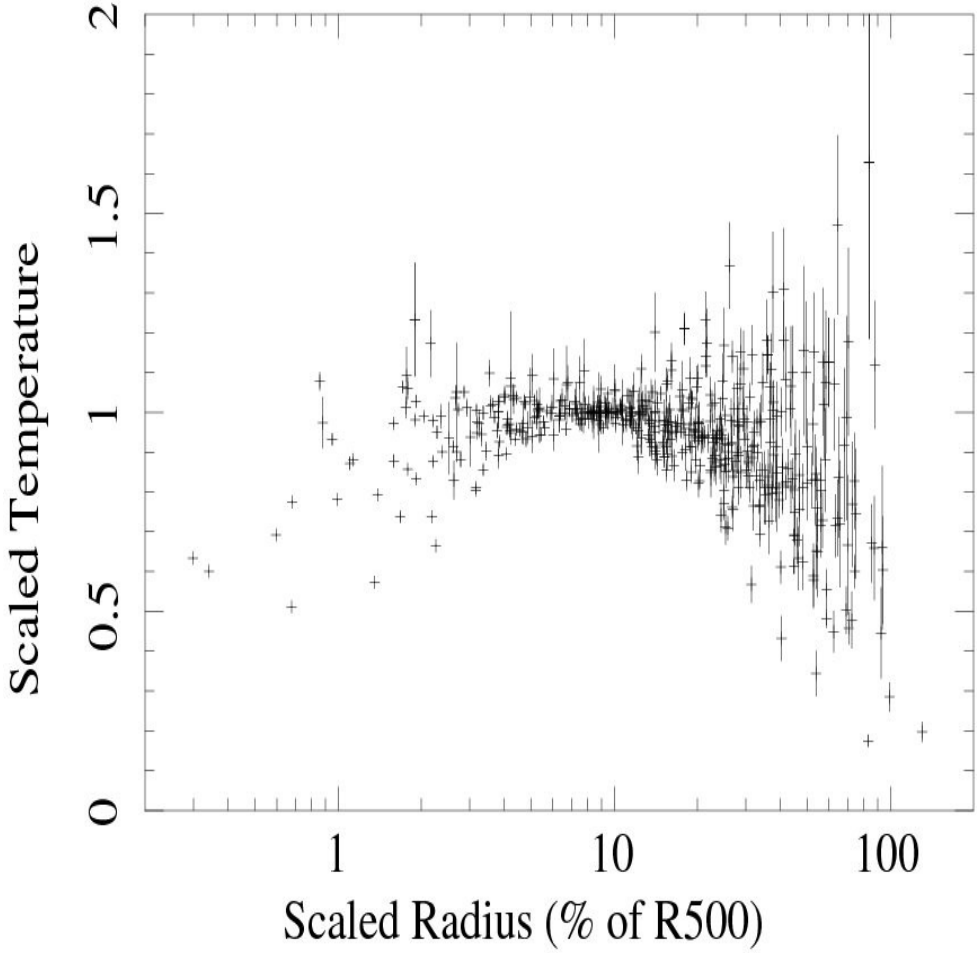
Entropy Distributions



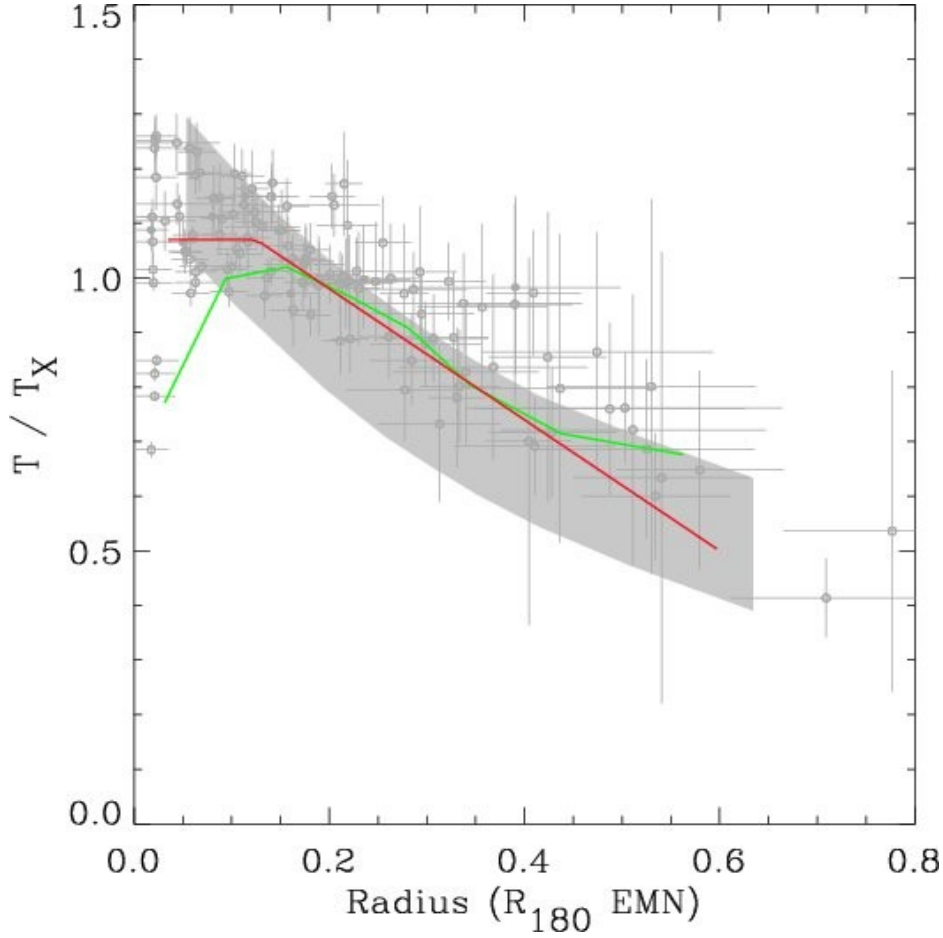
Some clusters show turnover in Entropy. Need better model of density distribution.

Temperature Distributions

Snowden et al. 2008

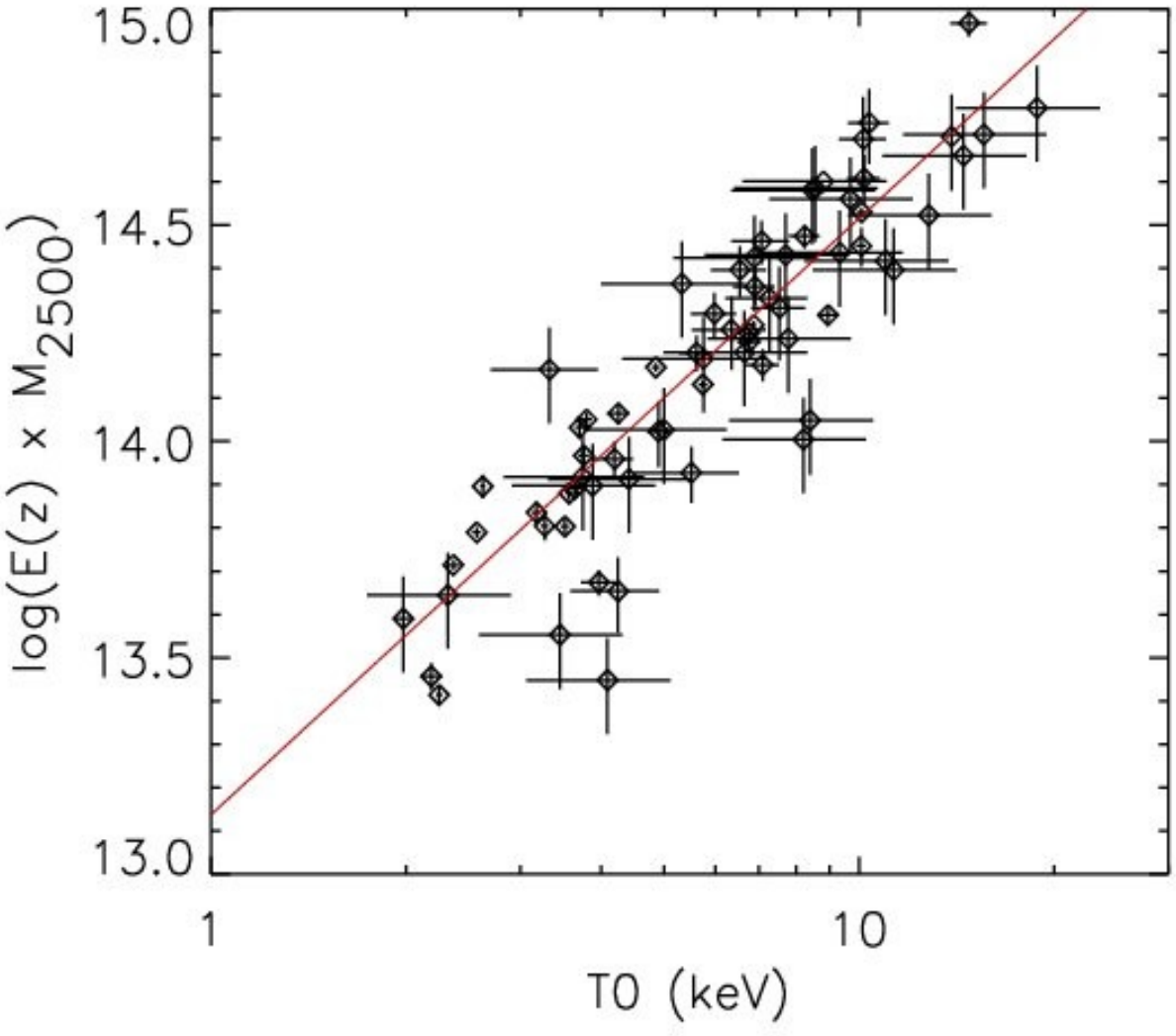


Pratt et al. 2007



We see much larger scatter in temperature profiles at large radius then previous studies.

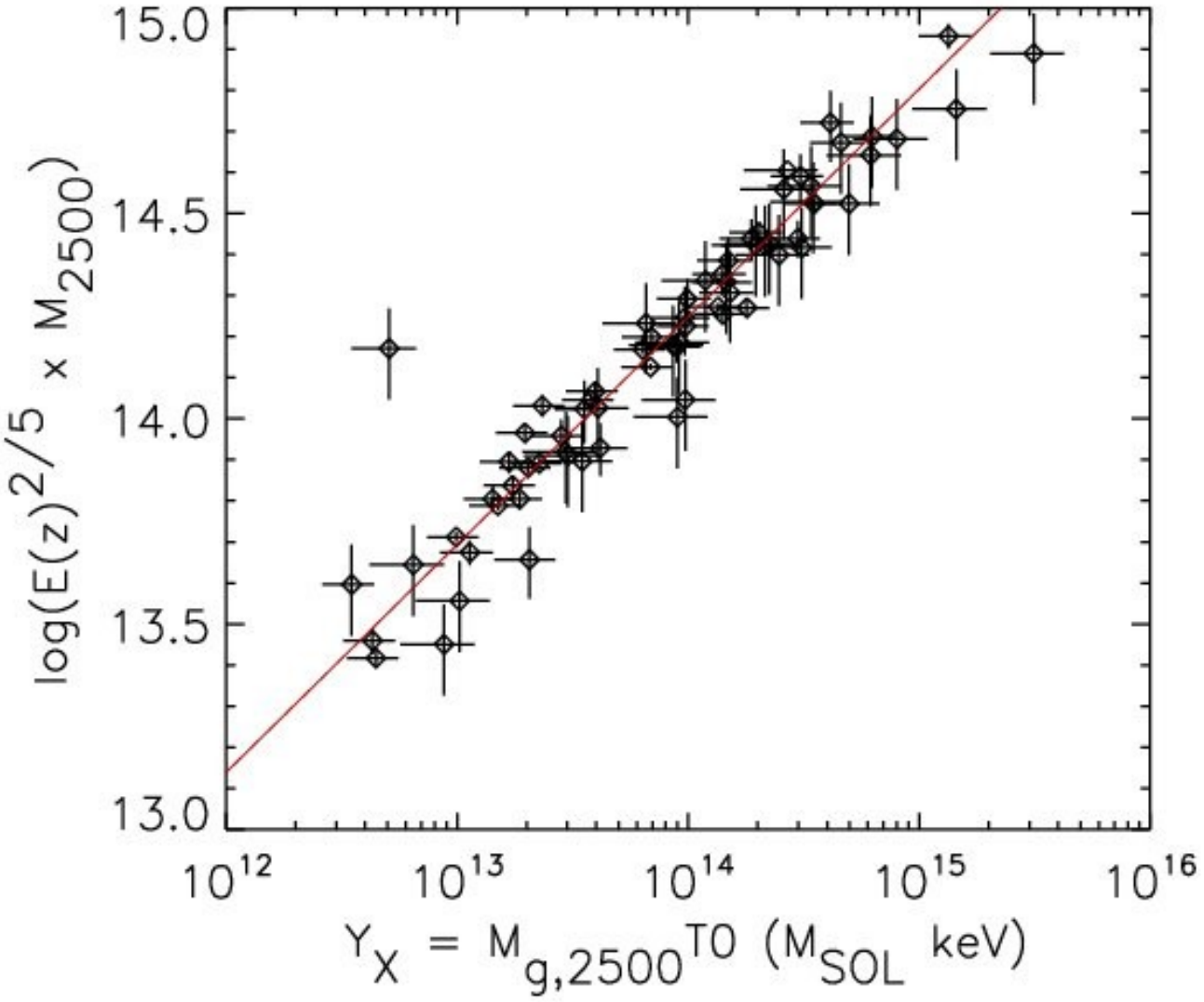
Mass-Temperature



Self similar:
$M \propto T^{1.5}$

Our Result:
$M \propto T^{1.38}$

Mass-Y_X



Self similar:

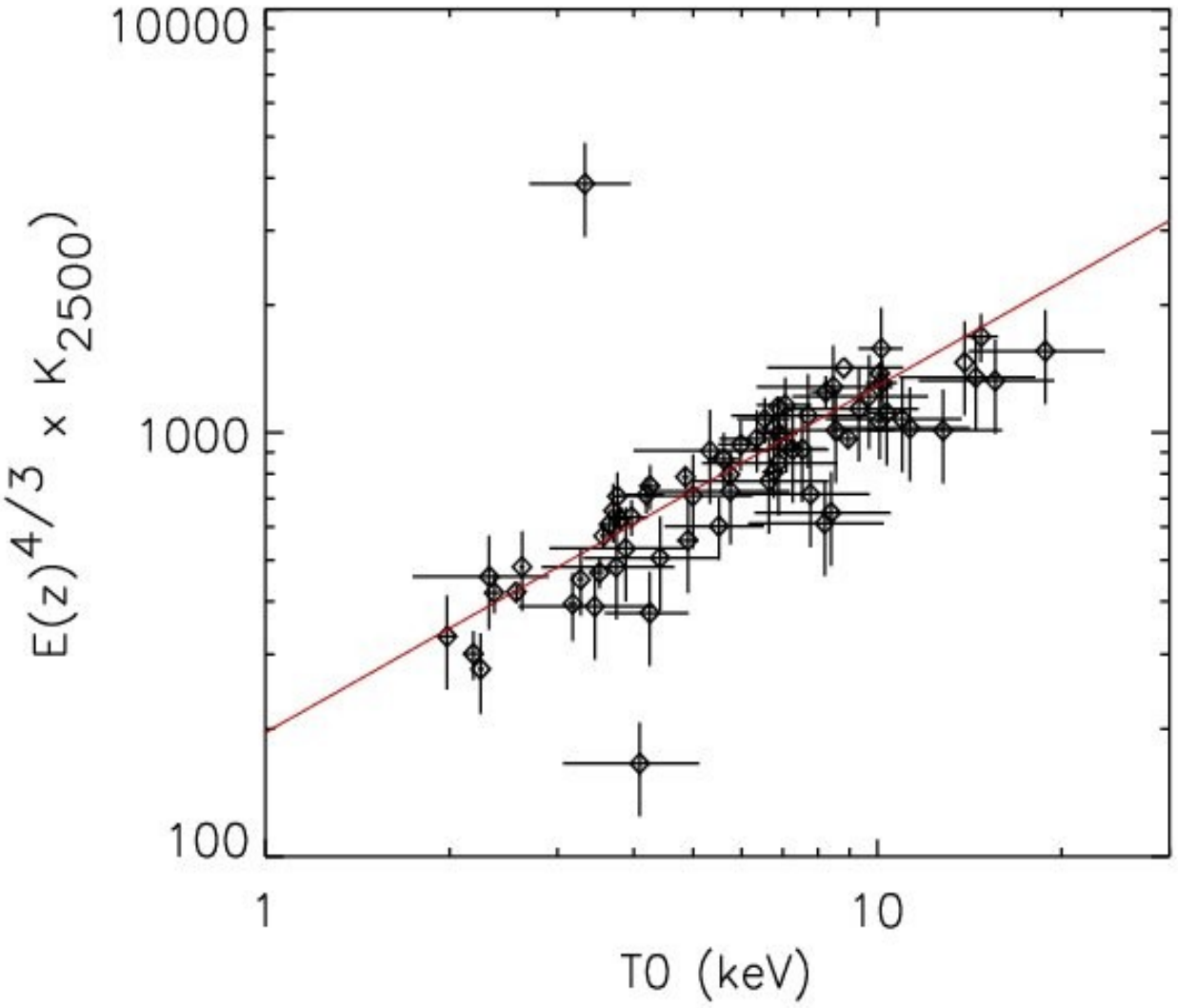
$M \propto Y_X^{0.6}$

Our Result:

$M \propto Y_X^{0.55}$

Scatter is 18%.
Less than the measurement error.

Entropy-Temperature



Our Result:

$K \propto T^{0.82}$

Nagai et al 2007:

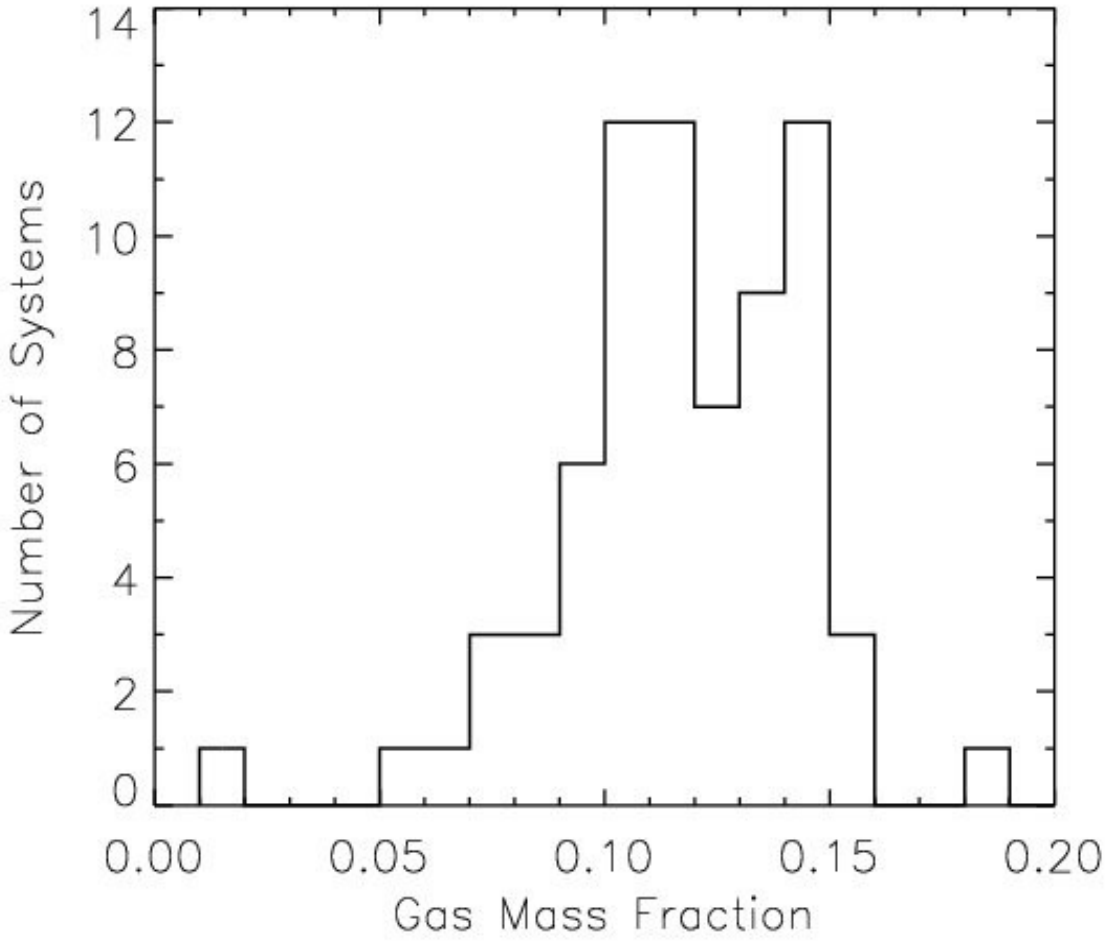
Sims: $K \propto T^{0.958}$

Chan: $K \propto T^{0.769}$

XMM: $K \propto T^{0.657}$

Normalizations Consistent

Clusters and Cosmology: Gas Mass Fraction

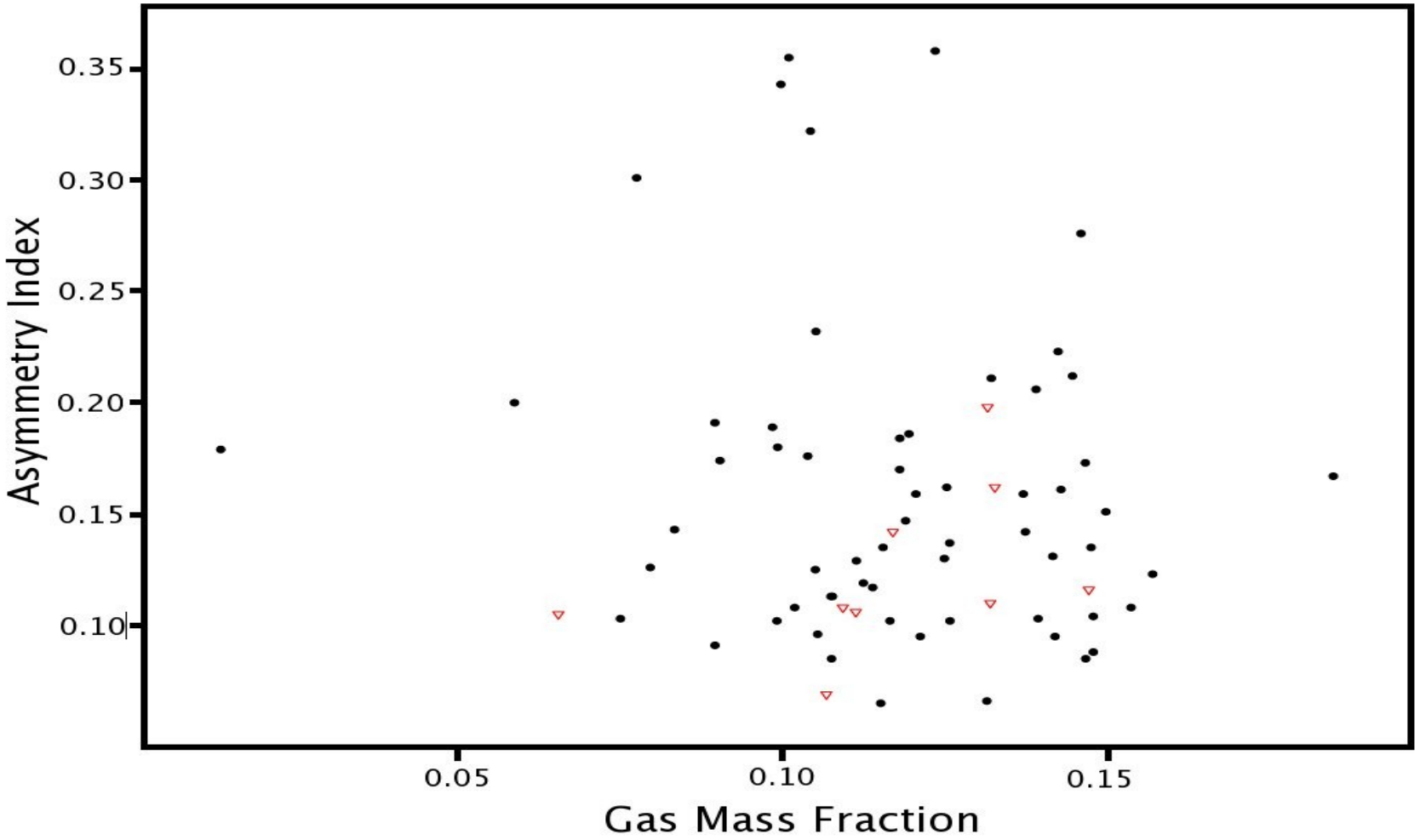


Weighted mean:
f = 0.1040

Allen et al. 2008:
f = 0.1104 (all)
f = 0.113 (low z)

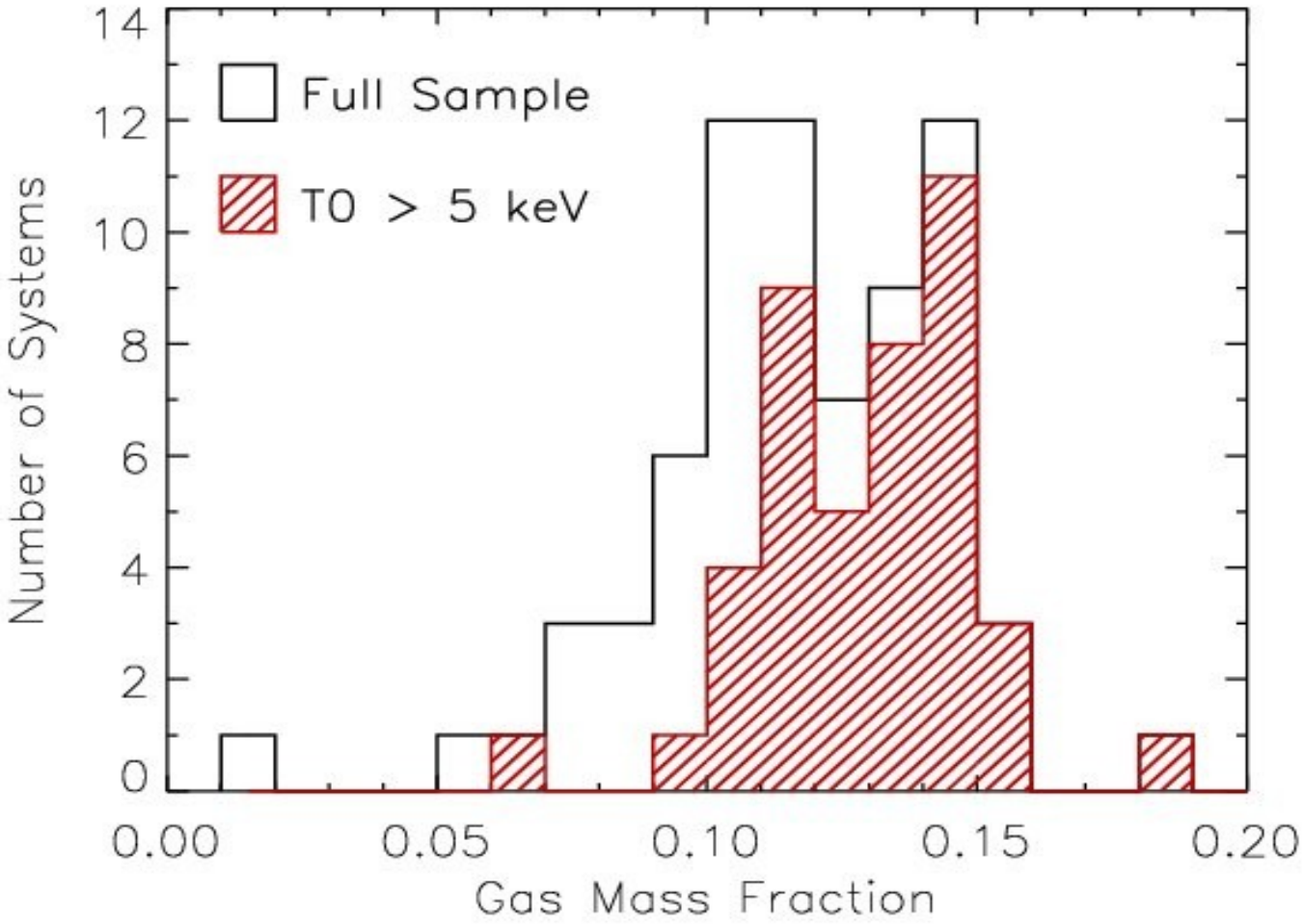
What differences in sample selection produce variation in f?

Substructure?



No Correlation between Cluster Gas Asymmetry and Gas Mass Fraction

Temperature Selection



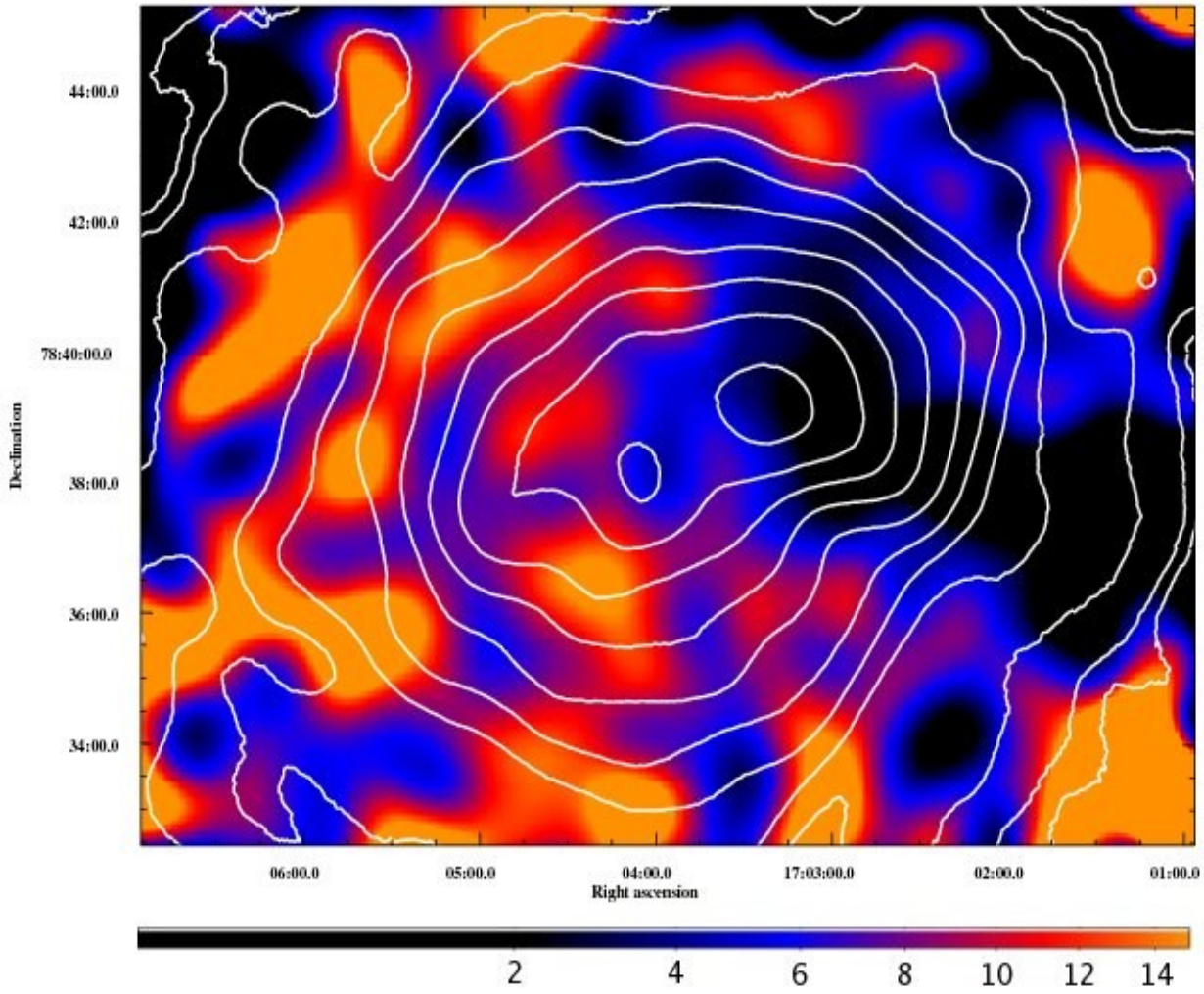
All:
f = 0.1040

T0 > 5 keV:
f = 0.1111

Temperature selection enough to account for difference (but Vikhlinin et al. 2006 not in agreement, f = 0.091).

Lots More To Do:

Temperature Map of Abell 2256



- How do properties vary with structure?
  - Both density and temperature.
- What temperature measure is best for correlations?
  - T_0, T_{spec}, T_{mg}
- Abundance?

Conclusions

- Our results agree reasonably well with other cluster samples.
- We verify that Y_X is a better proxy for cluster mass than temperature.
- Initial results suggest:
  - Level of substructure does not correlate with gas mass fraction.
  - Temperature is more important constraint for selecting high gas mass fraction clusters.
- Look for more results to come...